swisstopo

Bundesamt für Landestopographie
Office fédéral de topographie
Ufficio federale di topografia
Uffizi federal da topografia

Geodäsie

Seftigenstrasse 264
CH-3084 Wabern
Telefon +41 31 963 21 11
Telefax +41 31 963 24 59

www.swisstopo.ch

National Report to the CGSIC/IISC European Meeting in Prague March 14-15, 2005

Switzerland

1 National activities

a. Time / frequency activities

metrology and accreditation switzerland (metas) routinely uses GPS time transfer techniques for the comparison and synchronization of its eight atomic clocks with the clocks at the Observatoire de Neuchâtel. Moreover, the readings of these clocks are transferred by GPS to the Bureau International des Poids et Mesures (BIPM) in Paris as a contribution to the inter-national atomic time (TAI).

b. Survey / geodesy / GIS activities

The Astronomical Institute of the University of Berne (AIUB) hosts the Center for Orbit Determination in Europe (CODE) as one of the analysis centers of the International GPS Service (IGS) (see 3.g below). The Federal Office of Topography (swisstopo) closely cooperates with the AIUB in the operation of CODE. In addition swisstopo operates the Automatic GPS Network Switzerland (AGNES), which consists of 30 permanent GPS stations. AGNES is a multi-purpose network, serving as reference for national first oder surveys, scientific applications and positioning services. The receiver at the AGNES station "Zimmerwald" operates as an IGS fiducial station.

The data of the AGNES network are automatically processed every hour at swisstopo in order to estimate troposphere parameters, which are used by the Meteo Swiss for the computation of weather forecast models. Precise station coordinates are computed with a delay of about 3 weeks, using the final high-precision IGS orbits.

In 2004 the GPS-based high precision geodetic control network LV95 has been observed for the third time, resulting in a coordinate precision [rms] better than 1 cm for the horizontal position and 2 cm for the height (ellips.) for all 200 stations. The new (orthometric) height system LHN95 has been finalized. Using the new geoid model CHGeo2004 the ellipsoidal and orthometric heights agree at the cm level (some exceptions may be observed in the Alps).

Complete university tracks in geodetic/geomatic sciences are available at ETH Zurich and EPF Lausanne. Different courses on partial aspects of GPS and Satellite Geodesy are available at the AIUB and the FHBB (University of Applied Sciences).

2 Differential services

swisstopo operates differential GPS services over GSM and GPRS offering different levels of accuracy:

- **swipos-NAV** for applications with accuracies between 0.5 and 1.0 meter like GIS data collection, environment engineering etc.
- **swipos-GIS/GEO** for applications with cm-accuracy like cadastral surveying

Both services are based on AGNES and use the method of Virtual Reference Stations (VRS). swipos-NAV is free of charge, whereas swipos-GIS/GEO is a commercial service.

A similar service is also offered by the private company Swissat.

3 Development activities

a. Land use
The swipos positioning services are available over the Internet using NTRIP (Network Transport of RTCM via Internet Protocol). NTRIP has been declared an official standard within RTCM. Swisstopo also contributes to the EUREF-IP initiative.

Since 2001 GPS is used for the truck tolling (LSVA) on swiss highways in combination with DSRC (dedicated short range communication) techniques.

b. Maritime use
No special activities

c. Aviation use
skyguide as the Swiss Air Navigation Service Provider (ANSP) is responsible for the Air Traffic Management and for the corresponding navigation infrastructure in Switzerland. Several tests with EGNOS System Test Bed (ESTB) have been performed and one of the 34 EGNOS RIMS (Ranging and Integrity Monitoring Station) has been installed at Zurich airport. Validation work of EGNOS signal in space over Switzerland was launched during 2004.

GBAS Implementation to support Cat I Instrument Landing Procedures at Zurich International Airport is in preparation (site preparation, civil works approval, frequency allocation, etc.).
A presentation entitled "GNSS in Switzerland: Status of Aviation Projects and Issues" was made to the 44th CGSIC Meeting, September 2004, in Long Beach, CA, USA, describing current implementation projects (EGNOS, GBAS) and availability and spectrum issues.

d. Space use
Normal activities within the European Space Agency (ESA). For more information please contact the Swiss Space Office .

e. Military use
No information available

f. Time / frequency use
see above

g. Survey / geodesy / GIS
AIUB: The daily processing of IGS data at CODE allows to monitor coordinates and velocities of about 140 tracking stations (continental drifts), troposphere parameters for the stations (atmospheric water vapor content), earth rotation parameters (polar wobble, length of day), and electron content of the ionosphere (which is closely related to the solar activity). For all these parameters long time series are available covering several years. Other activities at AIUB involve the orbit determination for GLONASS satellites as well as for low earth orbit (LEO) satellites carrying GPS receivers, a time transfer experiment over an intercontinental baseline using GPS carrier phase, or the generation of 'observations' for a virtual reference station based on GPS observations of a reference network.

swisstopo has accomplished the new orthometric height system LHN95 by the end of 2004. Together with the new geoid model CHGeo2004 a very good consistency between ellipsoidal and orthometric heights within the 1-2 cm level was achieved. Within the project „Swiss-4D“ a kinematic model of the AGNES and first order control network LV95 will be computed.

IGP/ETHZ: Different applications and investigations in engineering surveying, crustal movements (Greece) and in dynamic airborne remote sensing (gravimetry, laser scanning) using GPS have been

developped and carried out. GPS meteorology (tomography, radiometry, spectrometry, 4D-modelling) as well as error influences are investigated.

TOPO/EPFL: the Geodetic Eng. Laboratory at the EPFL focuses on GPS/INS/Sensor integration for large-scale airborne mapping using LiDAR/digital camera data and road infrastructure surveying using video sequences. A miniature GPS/INS data logger has been realized and the current research concentrates on real-time mapping and control aspects. This includes investigations in high frequency (10Hz) GPS-RTK and GPS Inverse-RTK via Ethernet and GPRS networks that are applied also to sport-performance applications. Further research concerns combination of GPS with autonomous sensors for pedestrian navigation.

4 Industrial aspects

Leica AG (Heerbrugg, CH) is a leading manufacturer of GPS products for geodesy, surveying and navigation. Leica AG also sells the scientific Bernese GPS software package of the AIUB.

All other major companies for GPS (surveying) equipment like e.g. Trimble (www.allnav.ch) are also represented in Switzerland.

µ-blox AG manufactures one of world smallest GPS-chip set, which is used e.g. in the national truck tolling (see above) system. Together with Atmel (San Jose, CA, USA) a new A-GPS (Assisted-GPS) receiver has been developped for improved operation in difficult environments like e.g. urban canyons.

fela Management AG has designed and realized the swiss truck tolling system (LSVA). The main business of fela is electronics and telematics using GNSS and other positioning and communication technologies.

TEMEX is involved in the development of precise GNSS timing equipment and also in the development of the atomic clocks for the GALILEO satellites.

Headquartered in Manno, Switzerland, NemeriX is a venture-backed fabless semiconductor company specializing in ultra-low-power RF and baseband integrated circuits for the rapidly expanding GPS and wireless industries. Using a unique combination of innovative silicon architectures and full-custom layout techniques, the Nemerix chipset is the world's lowest power solution available today

5 National policy activities and decisions

The Swiss Radio Navigation Plan (CH-RNP) has been established in 1999. Several updates (in form of news letters) have been published during 2000 – 2004. The next major review of the CH-RNP is planned with the introduction of GALILEO.

First discussions about the formal participation of Switzerland (as non EU member) in the GALILEO program have been started during 2004.

6 Responsible national authorities

a. Land use
Swiss Federal Office of Topography (swisstopo)
Seftigenstr. 264
CH-3084 Wabern
Tel. +41 (0)31 963 21 11

b. Maritime use
(no national authority)

c. Aviation use
Federal Office of Civil Aviation (FOCA)
Maulbeerstr. 9
CH-3003 Bern
Tel. +41 (0)31 325 80 39

d. Space use
Swiss Space Office
CH-3003 Bern
Tel. +41 (0)31 324 10 74

e. Military use
Several institutions, e.g. the Bundesamt für Luftwaffen und Führungssysteme
Kasernenstr. 19
CH-3003 Bern
Tel. +41 (0)31 324 58 20

f. Time / frequency use
metrology and accreditation switzerland (metas)
Lindenweg 50
CH-3084 Wabern
Tel. +41 (0)31 323 31 11

g. Survey / geodesy / GIS
Swiss Federal Office of Topography (swisstopo)
Seftigenstr. 264
CH-3084 Wabern
Tel. +41 (0)31 963 21 11

h. Industrial affairs
Swiss Institute of Navigation (ION-CH)
http://www.ion-ch.ch

7 Relevant conferences / seminars / exhibitions held within the country

- Research Day Nav 2004, EPFL, Lausanne, 23 march 2004
- NAVIGARE 04, Winterthur, 18 june 2004, „Schweizer Luftfahrt im Wandel“

8 Details of the formally notified National Point of Contact

Urs Wild
Federal Office of Topography
Seftigenstrasse 264
CH-3084 Wabern

www.swisstopo.ch